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PROPHYLACTICS

IN CHARGE OF
MARY M. RIDDLE

[In the following paper and in others that may succeed it an attempt will be made to give an intelligent nurse a general idea of what has been accomplished in preventive medicine during the past few years. As bacteriology is the basis of all the advances in preventive medicine, it is certainly desirable that a nurse should have some idea of this science. It is not to be expected, neither would it be desirable, for a nurse to be an expert bacteriologist, but it is extremely desirable and all-important for the trained nurse to understand the whys and wherefores of the manipulations in the laboratory, in order that she may understandingly carry out the directions of the physician and surgeon regarding sterilization. It has been claimed that nurses are too highly educated, and, owing to this, are not willing to perform the necessary drudgery of their calling, but this is manifestly incorrect. It is the half-educated doctor and the half-educated nurse who feel that their dignity will be lessened should they perform a certain amount of drudgery. No well-educated physician and no well-educated nurse will ever fail in their duty to the patient because it entails on them a certain amount of drudgery.

The nurse has a very important duty to perform. She is the picket-guard. On her care and watchfulness the well-being of the patient very largely depends. On her report must depend the treatment adopted by the physician in a given case, and on it, in connection with the condition of the patient, the prognosis is frequently based. Important as constant watchfulness is in the non-infectious diseases, it is much more important in the infectious diseases. In this series of papers an attempt will be made to give an idea of the various symptoms to be observed in the earlier stages of the different infectious diseases, the importance of which cannot be overestimated. After a somewhat extended experience the writer can recall many instances where outbreaks of infectious diseases have been prevented by the watchfulness of nurses who have been carefully trained.]

THE RELATION OF BACTERIOLOGY TO PREVENTIVE MEDICINE

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THE great advances during the past few years in the science of bacteriology and the direct influence that these advances have had on preventive medicine, especially in the domain of infectious diseases, render the subject of the utmost importance not only to the profession at

large, but also to those who have the immediate charge of the public health. Edward Seaton, at the Eighth International Congress of Hygiene and Dermography, in a few words expresses the consensus of opinion of educated medical men on this subject. He says that progress in medical preventive work is retarded to a considerable degree by the popular or general conception of the scope of hygiene. "This in England (and a similar remark is true of this country) has come to have far too narrow a significance. The term hygiene is almost always used to apply to structural works (for example, water-supply and drainage), materials, etc., which, however important they may be as necessary for the prevention of some (so-called) preventable diseases, are apparently useless for the prevention of others which are also entitled to be called preventable. It will be impossible to combat diphtheria, influenza, and other diseases, which can only be properly termed preventable when the public and governments understand the necessity for the systematic encouragement of scientific observation and research bearing on the public health and the furtherance of medical preventive work generally."

No board of health can be considered well equipped for its work unless it has attached to it a bacteriological laboratory, not only for the immediate practical work of diagnosis, but also for the furtherance of extensive research. The reason why the Continental boards of health are superior to ours is the fact that there is a chance for this experimental research in addition to the routine work of the laboratory. Many of the most important discoveries have thus been made. Although bacteriology as a science is yet in its infancy, the researches of Leeuwenhoek more than two hundred years ago laid the foundation for all that has since been accomplished. Leeuwenhoek was not a man of liberal education, but was a linen-draper by trade. He, however, learned the art of lens grinding, and carried it to such perfection that he was able to see objects which from his description, as published in a paper presented to the Royal Society of London in 1683, leave little room for doubt that these bodies, which he called *animalculæ*, were the bacteria of the present day. Nothing was done at this time, and, indeed, for two hundred years, in the classification of these organisms or in studying their life history, which is a very important factor in differentiation of the various species. Pleneiz, a physician of Vienna in 1762, was a firm believer in the truth of Leeuwenhoek's theory. He claimed that the material of infection was a living substance, and explained in this way the variation of time in the incubation of different infectious diseases. This physician also advanced the theory that there was a special germ for each infectious disease, the truth of which theory has been shown by the light of our present knowledge on this subject. It was not, however, until the first half of the

present century that a number of important discoveries established the true relation of the lower organisms to infectious diseases. The question of spontaneous generation of the organisms occupied the attention of scientific men for nearly two hundred years. In 1749 Needham thought that he demonstrated conclusively that these organisms were developed spontaneously, but the laxity of his method was shown by Spallanzani in 1769. From the time of the experiments of Spallanzani until the time of Schulze in 1836 no advance was made in this subject. In 1860 Hoffman and in 1861 Pasteur demonstrated that by closing the top of a flask by a loose plug of cotton the entrance of organisms would be prevented. This is the method that is in daily use in the laboratories. The previous observers had drawn the top of the flask to a narrow point or had passed the air through strong acid solutions or through highly heated tubes.

The next step in advance was the use of the oil immersion lens and the Abbé condenser, which throws a flood of light on the slide under the microscope. But perhaps the most important discovery was the use of solid culture media. Previous to its use it had been impossible without great difficulty to obtain a pure culture of any organism. It is impossible to study any of the various organisms without first obtaining a pure culture. The solid culture media now in general use are a ten per cent. solution of gelatin in beef-broth and also agar, a production from a Japanese sea-plant, and a component part in the well-known lacquer varnish. The advantage of agar is the fact that it does not liquefy at the temperature of the incubator, and hence is a useful adjunct in cultivating organisms at the temperature of the body. Solidified blood-serum, egg albumen, and bread paste are used in the manipulations of the laboratory. Loeffler found that the bacillus of diphtheria grew more characteristically on blood-serum than on any other culture medium. The use of Petri dishes, which are small, flat dishes of glass about four inches in diameter, simplifies the work in the laboratory to a very considerable extent. The use of the aniline colors for staining micro-organisms and the staining reaction for purposes of differentiation have been important steps in the advancement of bacteriology.

This short and imperfect outline of this science gives no idea of the immense amount of patience required to establish a few well-recognized and accepted facts. The number of non-pathogenic organisms that have been discovered is very large, but the number of pathogenic organisms is not very great; enough work, however, has been done in this line, and a sufficient number of organisms proved to be the cause of certain infectious diseases have been isolated, to prove of great benefit not only to preventive medicine, but also to general medicine. The study of the

pathogenic bacteria alone is of importance to the physician, interesting as the study of the non-pathogenic may be. Ehrenberg in 1838 and Dujardin in 1841 considered all bacteria to be infusoria, but now they are recognized as vegetable micro-organisms differing essentially from infusoria, which are unicellular animal organisms. The difference between animal and vegetable organisms is the fact that the former receive food into the interior of the body, assimilate the nutritious portion, and extrude the non-nutritious residue, while the latter are nourished through the cell-wall by organic or inorganic substances held in solution. The term bacteria comprises a large group of these minute vegetable organisms, which multiply by a process of transverse division. They are spherical, oval, rodlike, and spiral in shape, and are commonly devoid of chlorophyll. These organisms are divided into two great classes,—saprophytes, which obtain their nutrition from dead organic matter, and parasites, which thrive always at the expense of some other living organism, and cannot, as a rule, develop upon dead matter. Some of these organisms, however, have the property of a dual existence, accommodating themselves to the surroundings, at one time leading a parasitic and at another time a saprophytic form of existence. These organisms are known as facultative parasites or saprophytes. The pathogenic organisms are parasites, or in certain instances facultative saprophytes.

Bacteria are also divided into aërobic and anaërobic; that is to say, certain of them grow in the presence of oxygen, and certain others will not grow in the presence of oxygen. A notable example of the latter class is the bacillus of tetanus, and it emphasizes the importance of free incisions in punctured wounds where there is any suspicion of the entrance of the bacillus of tetanus. Bacteria are also divided into cocci, or round bodies, in which all of the diameters are equal; into bacilli, in which one diameter is longer than the other; and spirilla, in which the organisms are curved when seen in short segments, or when in longer threads are twisted in the form of a corkscrew. Cocci are divided into staphylococci, growing in masses like clusters of grapes, and streptococci, those growing in chains; diplococci, those growing in pairs, and tetrads, those developing in fours. Certain of these organisms have spores, and the presence or absence of spores has an important bearing on the subject of disinfection, spore-bearing organisms being extremely difficult to kill. It is this fact that led Tyndall and Pasteur to adopt the process of fractional sterilization, which is now used in every laboratory. This process consists in subjecting the culture medium to be sterilized to a temperature of 100° C. for fifteen or twenty minutes for three successive days, the object being to destroy all the mature organisms at the first sterilization and then allow the spores to sprout and be

destroyed at the second and third sterilizations. Experience has proved that three sterilizations are sufficient to destroy all organisms that may be present in the culture medium.

Time will not permit of any further account of bacteriology in general, but a study of some of the most important of the pathogenic micro-organisms may be of interest. The infectious disease known as anthrax, or malignant pustule, has been demonstrated to be due to a known specific organism, the bacillus anthracis. This organism was discovered by Davaine in 1850. He found this bacillus in the blood of infected animals and demonstrated the etiological relation of the organism to the disease. This bacterium is a bacillus of moderate size and stains readily with the usual aniline colors. It bears a very marked resemblance to the bacillus subtilis, from which it can be distinguished by its non-motility. It is a spore-bearing organism, and for this reason it is extremely difficult to kill. In the countries where the disease most frequently prevails it has been found that the bodies of animals dead from the disease, although buried two or three feet deep, were sources of infection for a very considerable period of time. Fortunately, in this country the disease is comparatively rare, being usually found on workers in wool, hence its name, "wool-sorters' disease," or among those who handle horse-hair. This bacillus is pathogenic for cattle, sheep, horses, rabbits, guinea-pigs, and mice. White rats, dogs, and frogs are not susceptible to the disease. Man is not particularly susceptible, but may be subject to local infection from accidental inoculation, giving rise to malignant pustule, or to anthrax of the lung contracted from inhaling the spores of the organism while sorting wool or hair from infected animals. Where a partial immunity has been acquired as the result of inoculation with attenuated virus, hypodermic injections of a pure culture sometimes may give rise to a slight local inflammatory process with a certain amount of effusion of bloody serum, in which the bacillus is found in considerable numbers, but the blood is not invaded by the organism and the animal recovers after a slight illness. In 1892 Petermann made a series of experiments with cultures of the anthrax bacillus filtered through porcelain. He found that these cultures injected into the veins of susceptible animals had a certain preventive action, but the immunity was only transitory, lasting not longer than a month or so. Strauss, Chamberlain, and others have established the fact that the anthrax bacillus may pass from the mother to the fœtus in pregnant females. Wolff, however, has shown that this does not always occur. The question of the entrance of the virus in this way is a very interesting point and merits further and more extended investigation.

(To be continued.)